



Engineers at JPL proposed a solution to the blood-cell freezing problem first identified by the Research Triangle Institute Biomedical Application Team during discussions with the National Cancer Institute. JPL's solution utilized a special electronic circuit developed for precise temperature control of scientific instrumentation now on its way to Mars on board the Viking spacecraft. JPL then turned the idea over to the Goddard engineers for implementation, since the Goddard Center was geographically more convenient to the National Cancer Institute.

The freezing unit monitors the temperature of the cells themselves. A thermocouple placed against a polyethylene container relays temperature signals to an electronics system, which in turn controls small heaters located outside of the container. The heaters allow liquid nitrogen to circulate at a constant temperature and maintain a consistent freezing rate.

Freezing white blood cells is important in leukemia work. There are more than 80 types of white cells, making patient-donor matching difficult. Storage life of unfrozen white blood cells is only a few hours.

The Goddard freezer, which was delivered last year to the cancer institute, can freeze up to 220 ml of white blood cells in one hour. Animal bone marrow also is being frozen by the unit for transplant research. Results so far are encouraging.

### Better physician's 'black bags'

There's a limit to what a physician can carry in his "black bag." But NASA-Johnson is extending that limit dramatically by transferring technology accrued through monitoring of astronauts' vital signs.

The development is evolving now in preparation for providing diagnosis and treatment of space-shuttle crew and passengers. Of course it can be adapted to aircraft, shipboard, and physician emergency calls too.

The portable medical-status system contains an electronic vital signs monitor, a cassette machine for recording electrocardiograms and electroencephalograms, equipment for minor surgery, as well as conventional diagnostic instruments such as the stethoscope, and drugs.

The big job was to make it all portable. Liquid-



*Portable medical status system—a highly advanced physician's "black bag"—weighs less than 30 lbs, yet contains equipment for monitoring and recording vital signs, electrocardiograms, and electroencephalograms. "Black bag" is outgrowth of astronaut-monitoring technology.*

Crystal displays are used to present 15 digits of data simultaneously for long periods of time without excessive use of battery power. A single printed-circuit card contains all the circuitry required to measure and display vital signs such as heart and respiration rate, temperature, and blood pressure.

So far the unit measures 7 x 22 x 14 inches and weighs less than 30 lbs. It will be field-tested this year, even as efforts continue to reduce the size further.